

VERIFICATION OF TRANSITION PREDICTION FOR FLOWS WITH SUCTION USING LINEAR STABILITY THEORY AND e^N -METHOD

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A validation study of RANS transition prediction using linear stability theory and the e^N -method for flows with suction has been carried out. The input data for the stability analysis is taken from the RANS solution where the suction velocity at the surface is introduced by a mass flux boundary condition. The prediction capability of the e^N -method is validated using different two- and three-dimensional experimental test cases, such as the flows over a flat plate, a NACA 64₂-A-215 airfoil (Fig. 1, Ref. [1]), a NACA 64-A-010 airfoil and the flows over swept wings with an ONERA D airfoil section and an ONERA DTP-B airfoil section (Fig. 2, Ref. [2]). If disturbances introduced to the flow due to the suction process itself or due to the surface roughness caused by the suction holes are considered by a reduced critical N -factor good agreement of the predicted transition locations with experimental data is obtained.

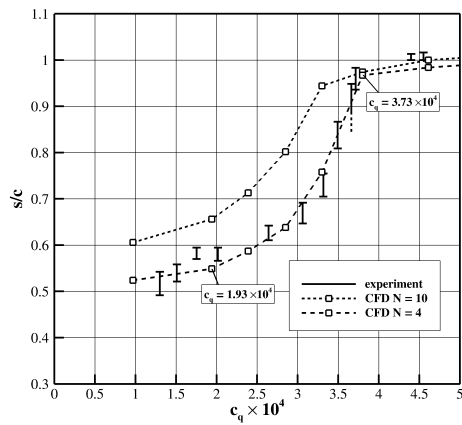


Figure 1: Measured and predicted transition locations, NACA 64₂-A-215.

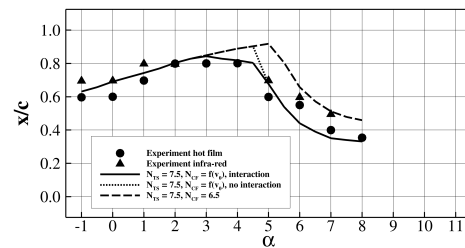


Figure 2: Measured and predicted transition locations, $v_0 = -0.050\text{ m/s}$, ONERA DTP-B.

REFERENCES

- [1] Van Ingen, J. *Theoretical and experimental investigations of incompressible laminar boundary layers with and without suction*. Technische Hogeschool Delft, Rapport VTH-124 (1965).
- [2] Gasparian, G. *Étude expérimentale et modélisation des mécanismes de transition sur aile en flèche, avec application au maintien de la laminarité*. Ph.D. thesis, École nationale supérieure de l'aéronautique et de l'espace (1998).